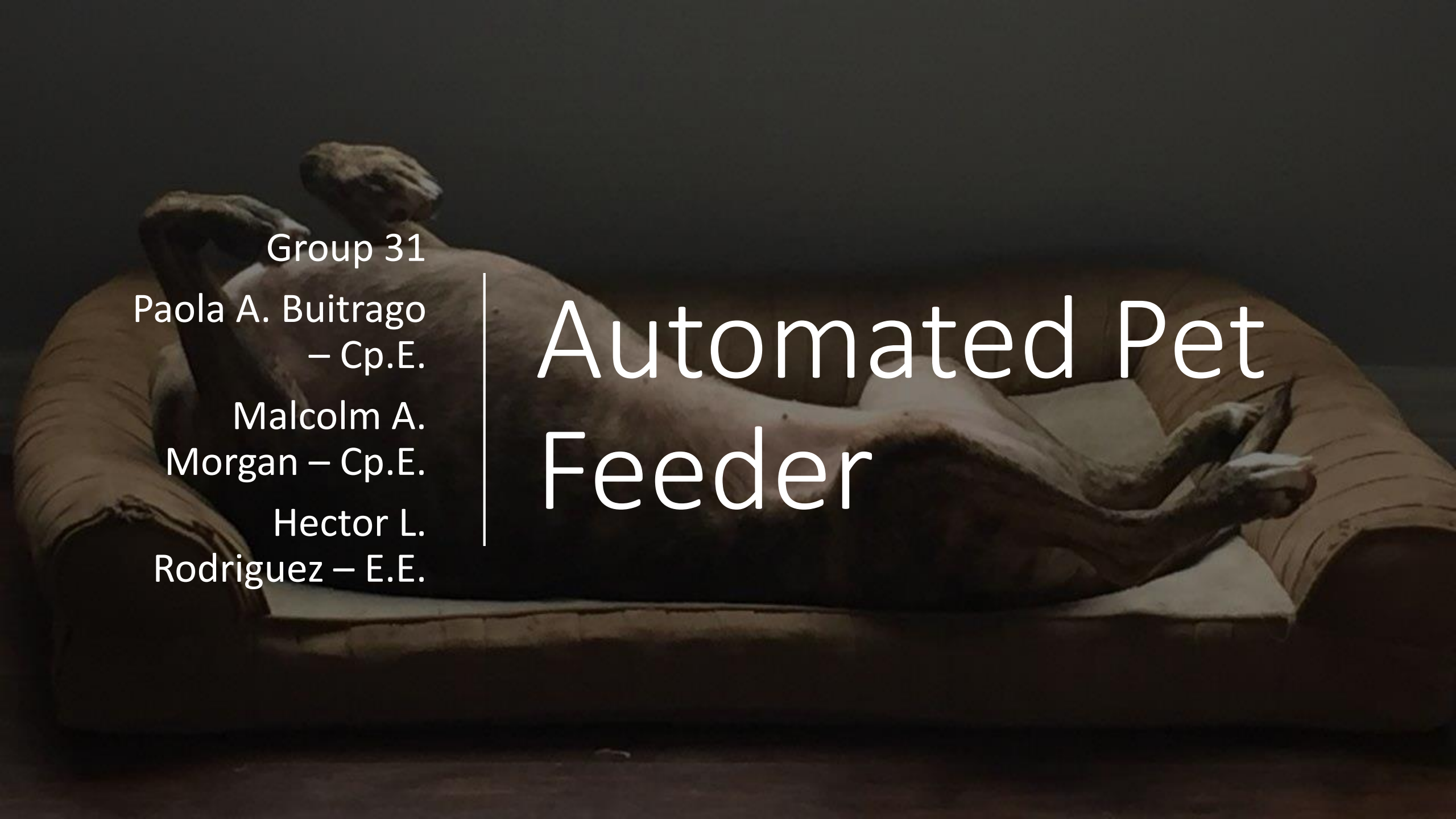


Group 31

Paola A. Buitrago – Cp.E.

Malcolm A. Morgan – Cp.E.

Hector L. Rodriguez – E.E.

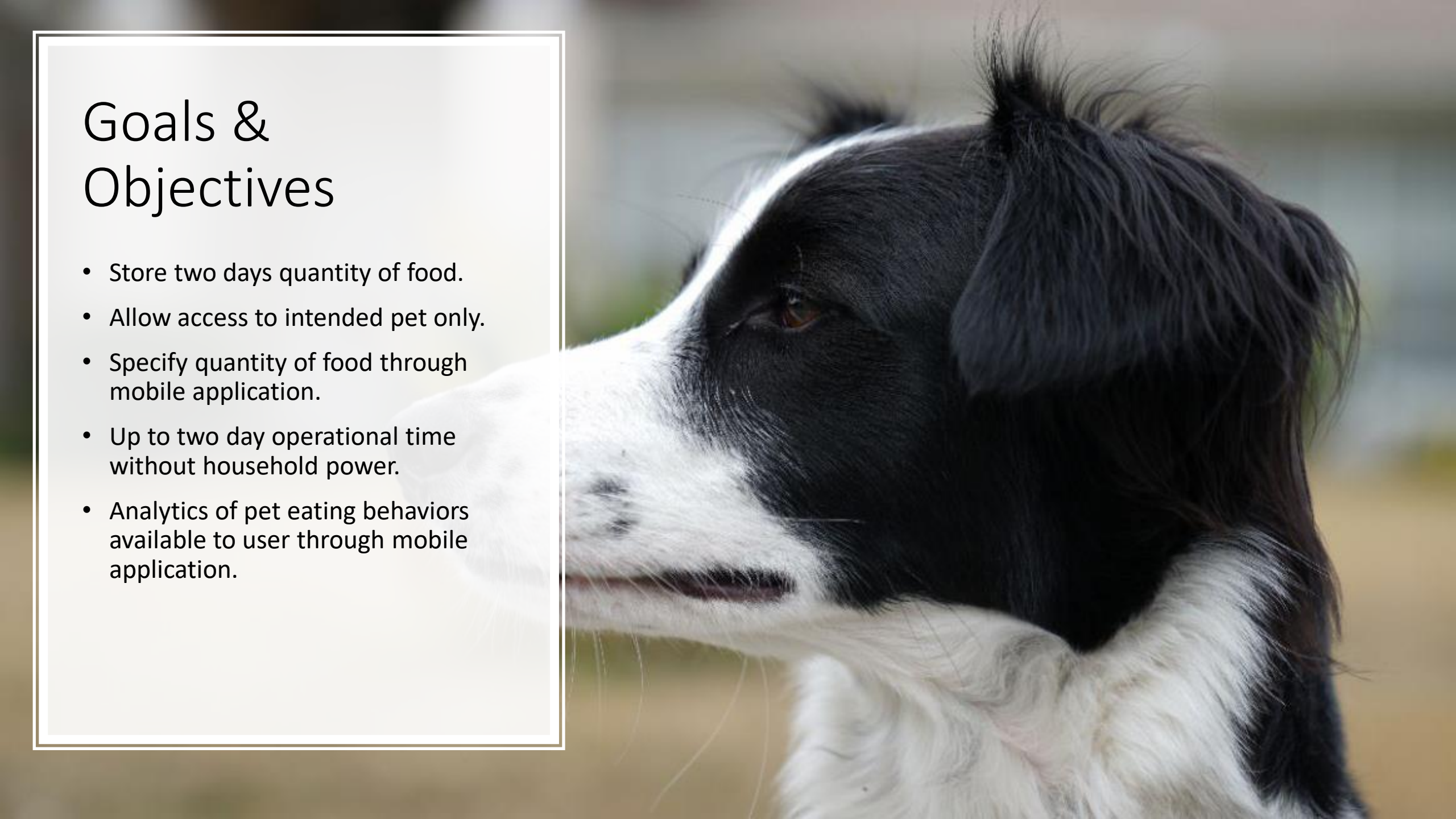
Automated Pet Feeder

Motivation

- Greater than 89 million household dogs in the United States.
- Feeding pets may not always happen on schedule.
- Emergencies occur; eating schedule disrupted.
- Ownership of multiple dogs

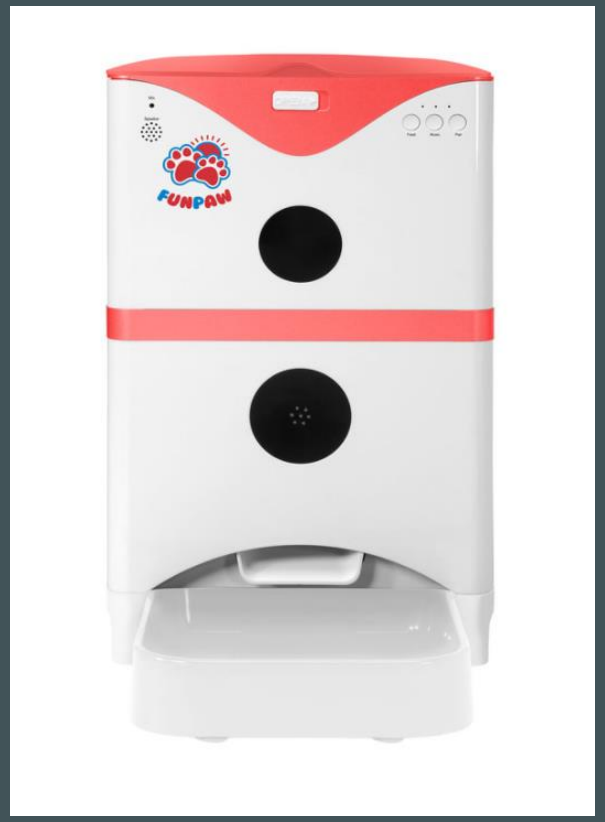
Goals & Objectives

- Store two days quantity of food.
- Allow access to intended pet only.
- Specify quantity of food through mobile application.
- Up to two day operational time without household power.
- Analytics of pet eating behaviors available to user through mobile application.



Currently on the Market: FunPaw and PetNet

- Provides Portion Control for pets
- Able to dispense food via app
- They send push notifications of when food is dispensed
- Set scheduled feeding times
- FunPaw provides video stream
- None is these feeders incorporate water feature

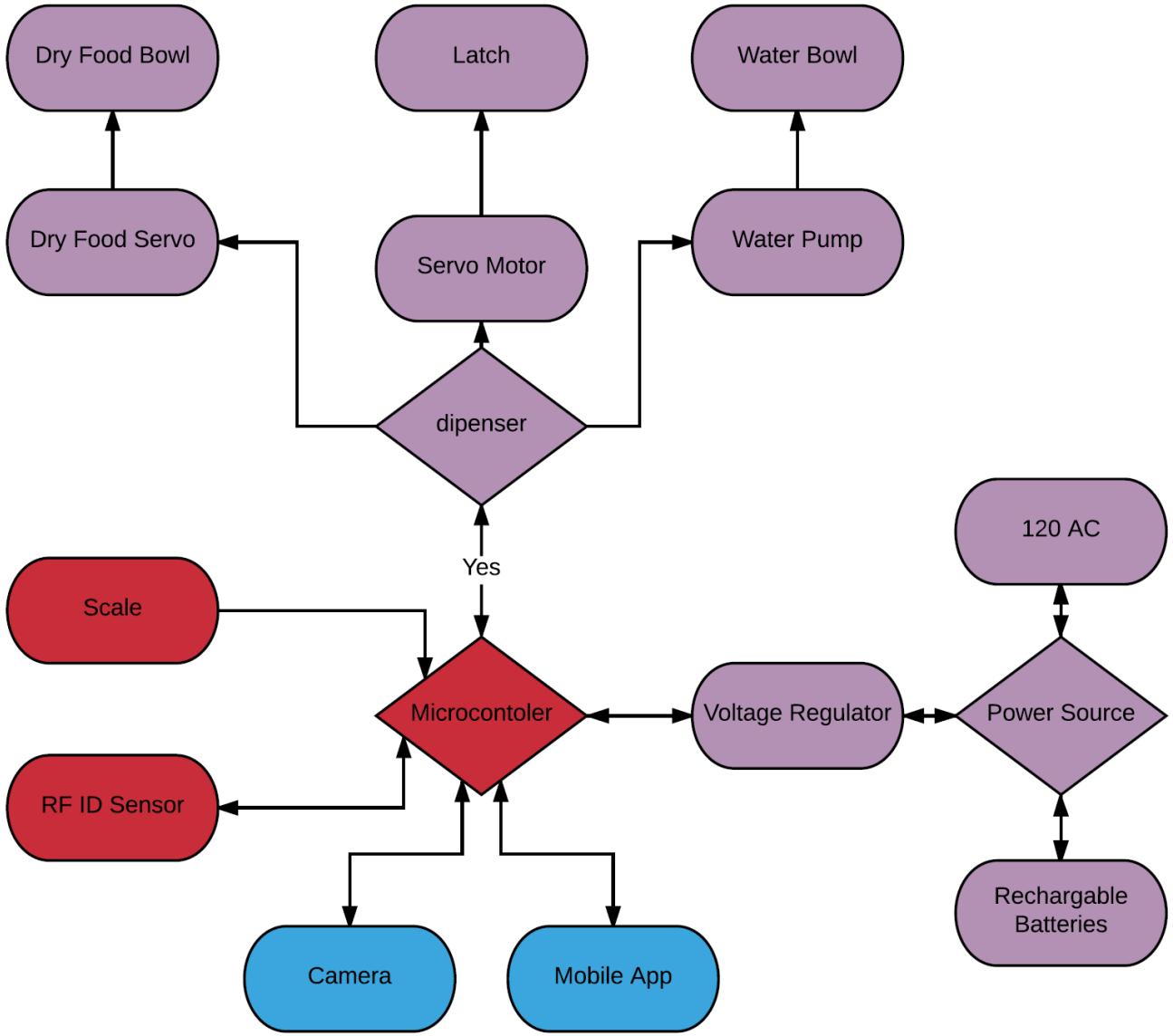


Hardware Block Diagram

Hector Rodriguez

Malcolm A. Morgan

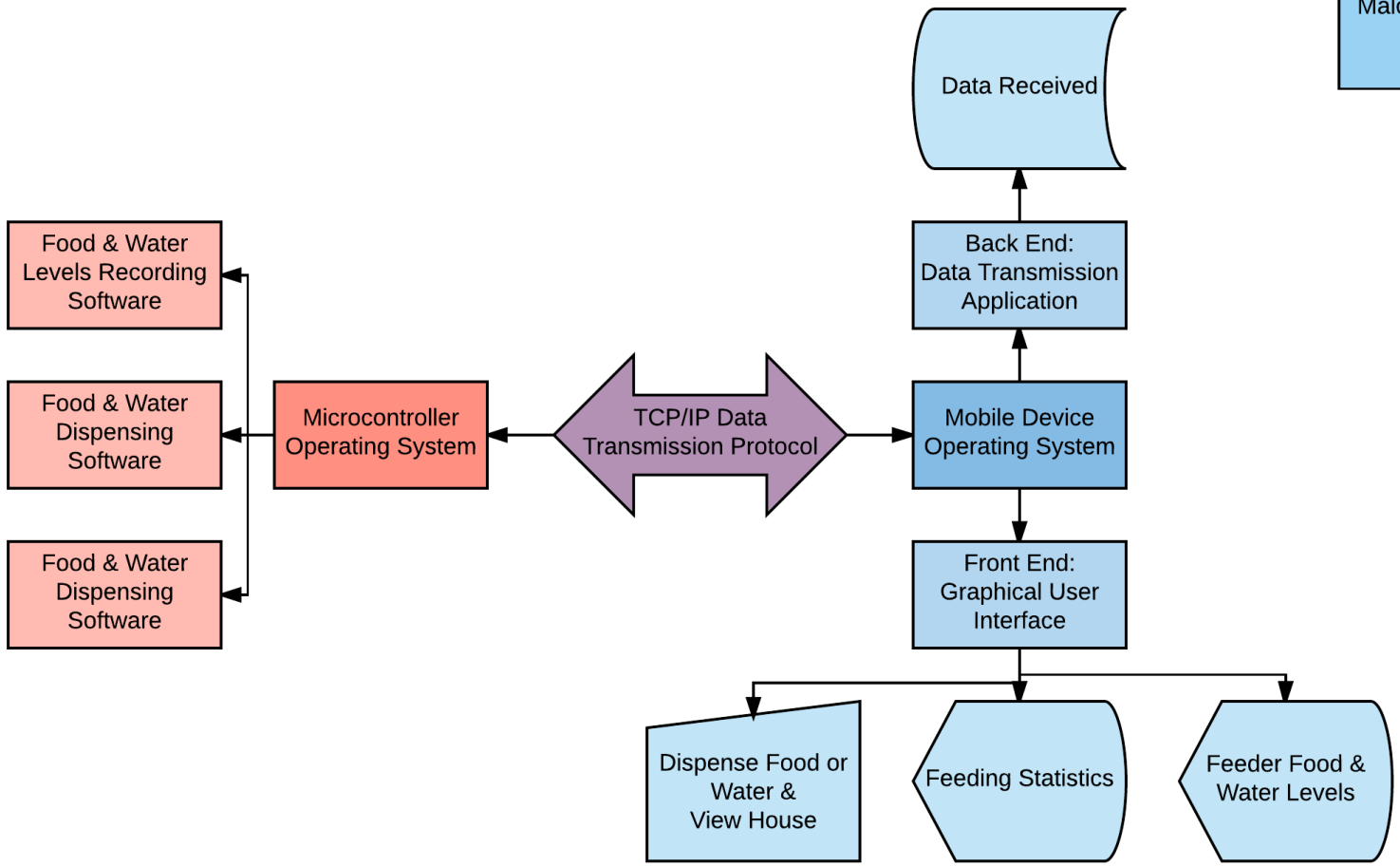
Paola A. Buitrago



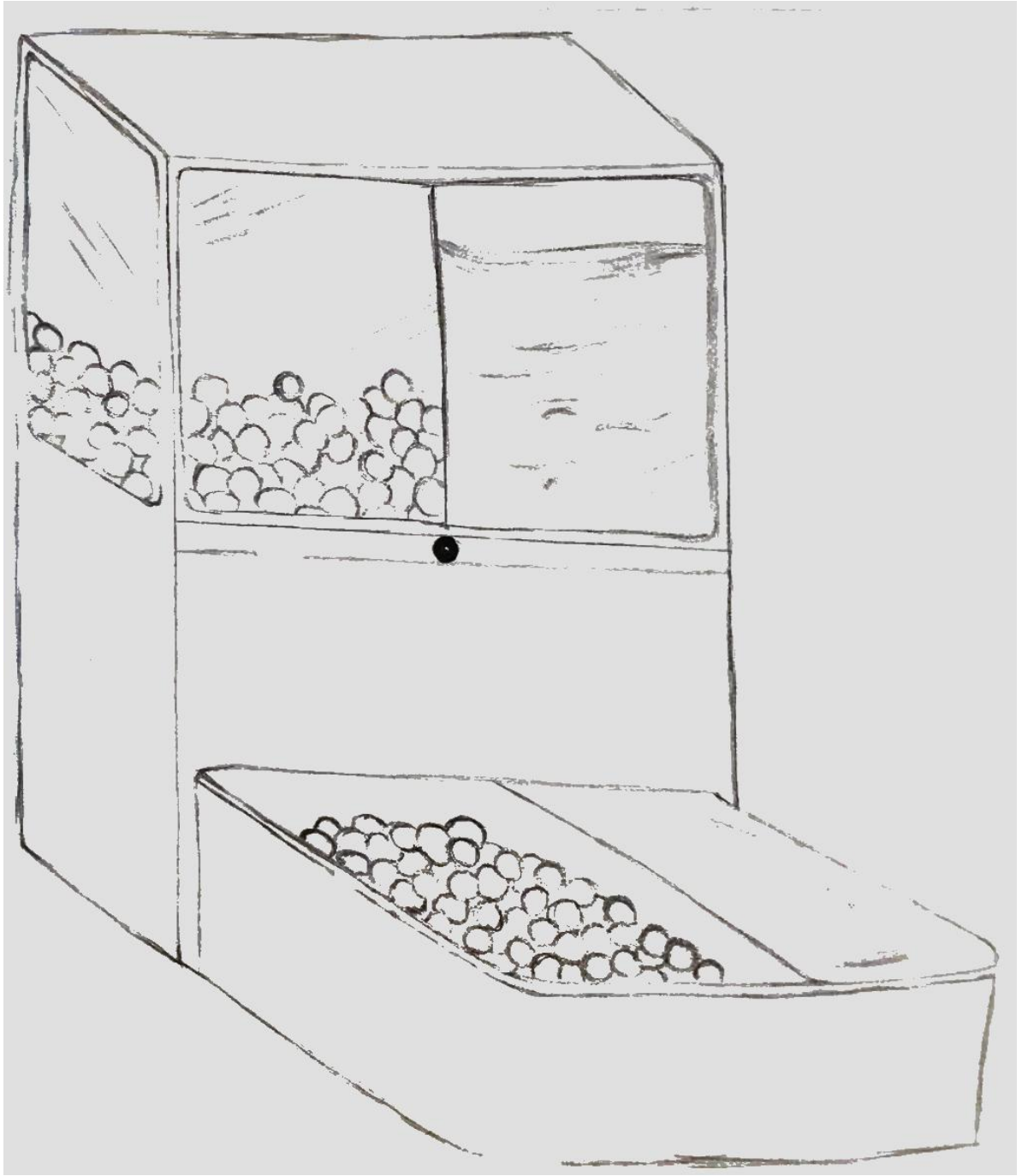
Software Block Diagram

Paola Buitrago

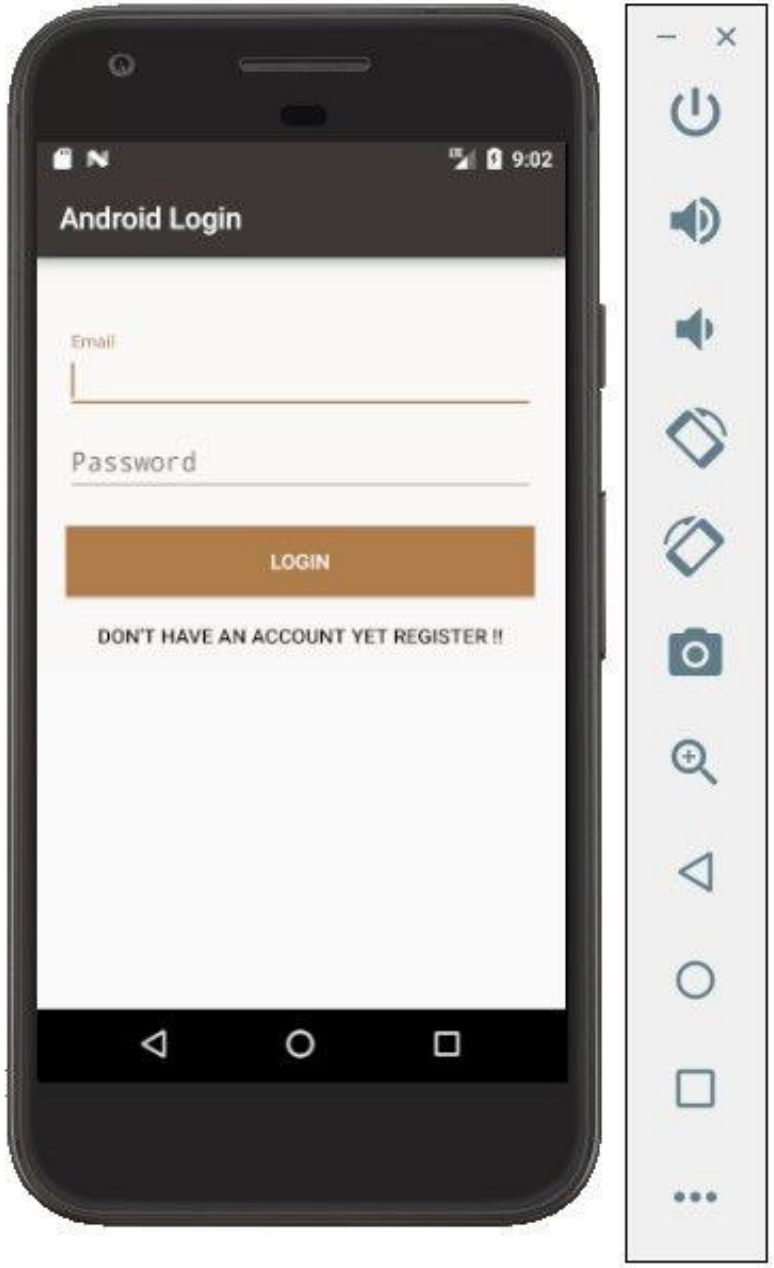
Malcolm Morgan



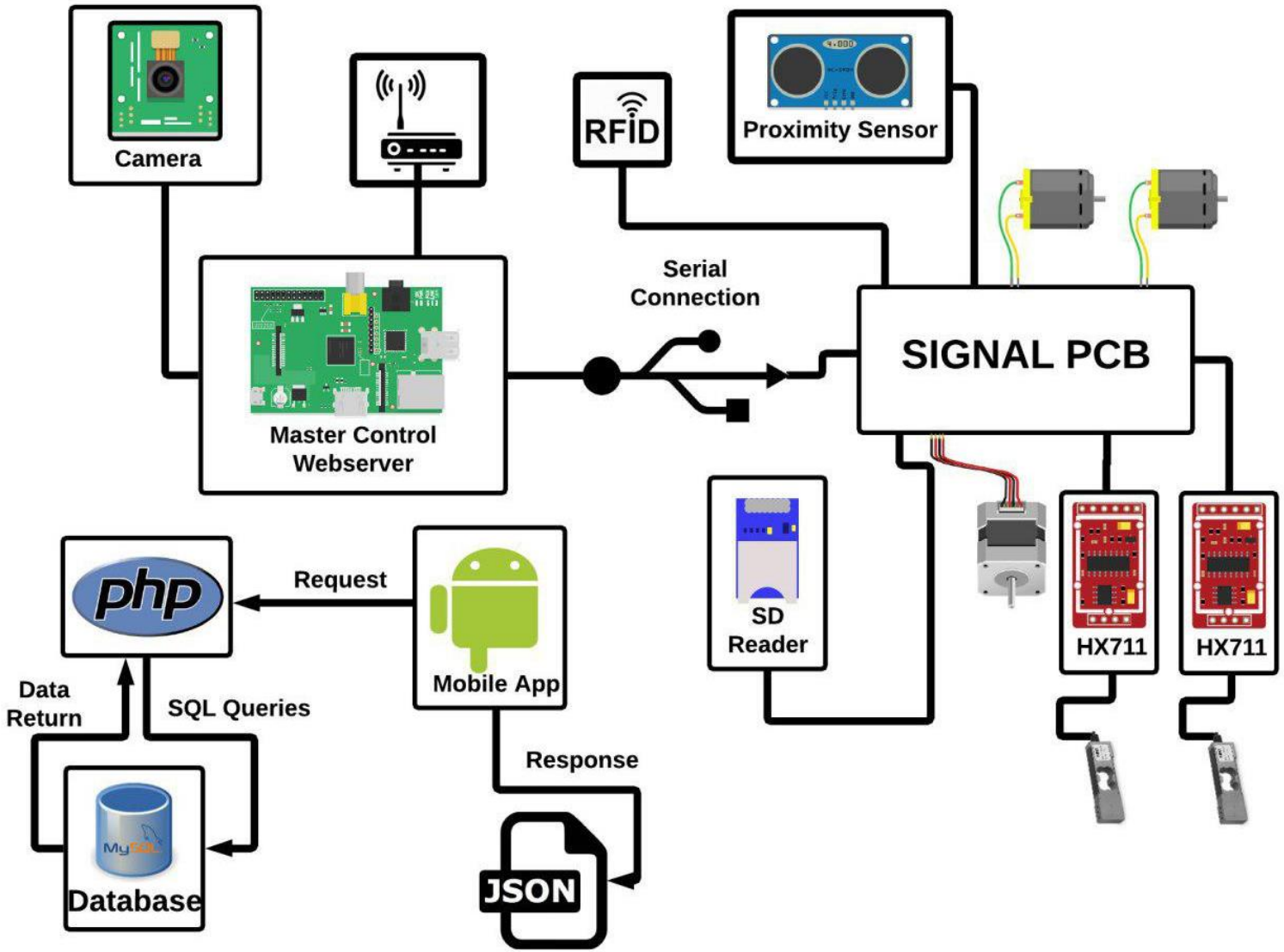
Enclosure Sketch



Mobile Application



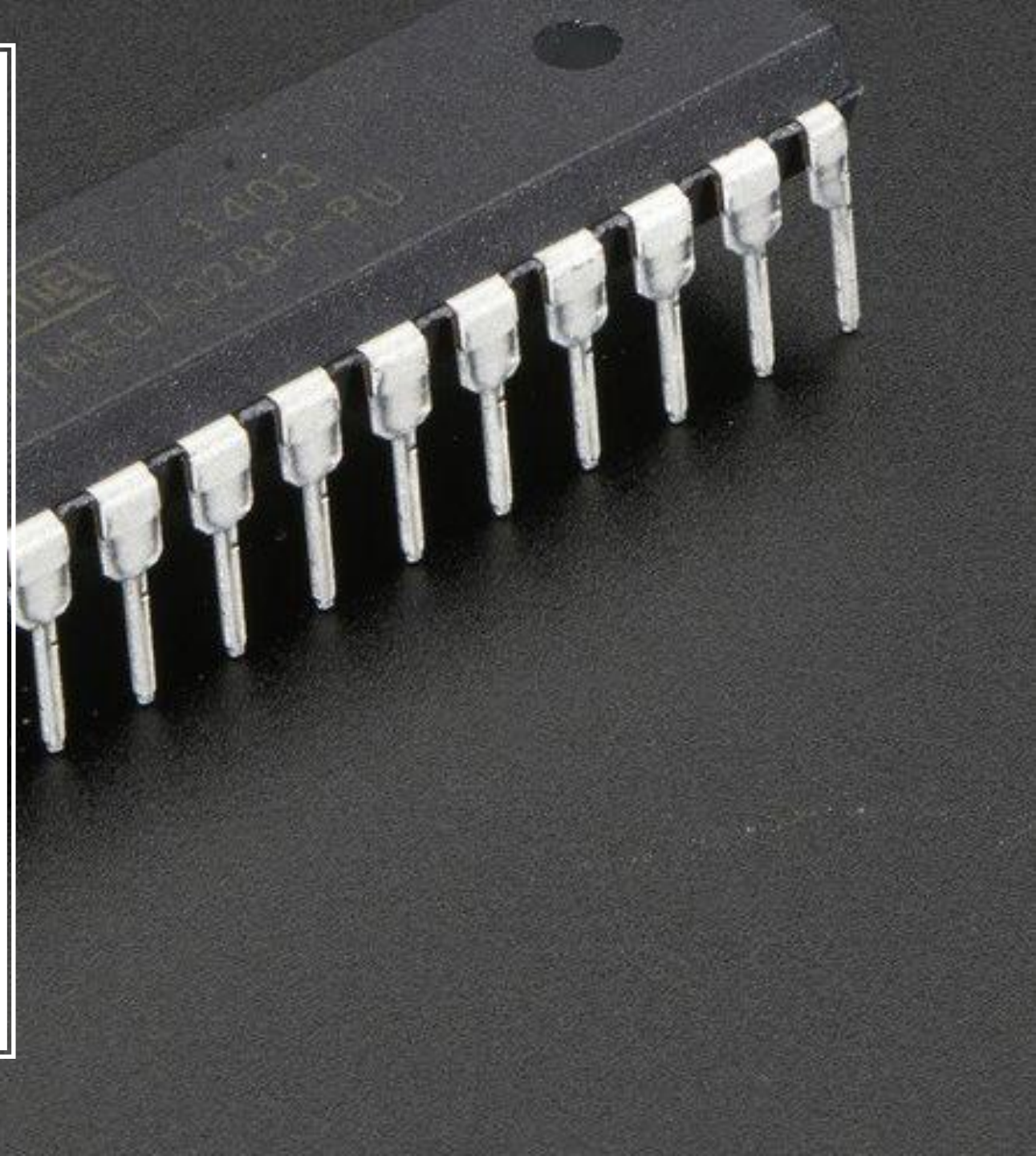
Overall System



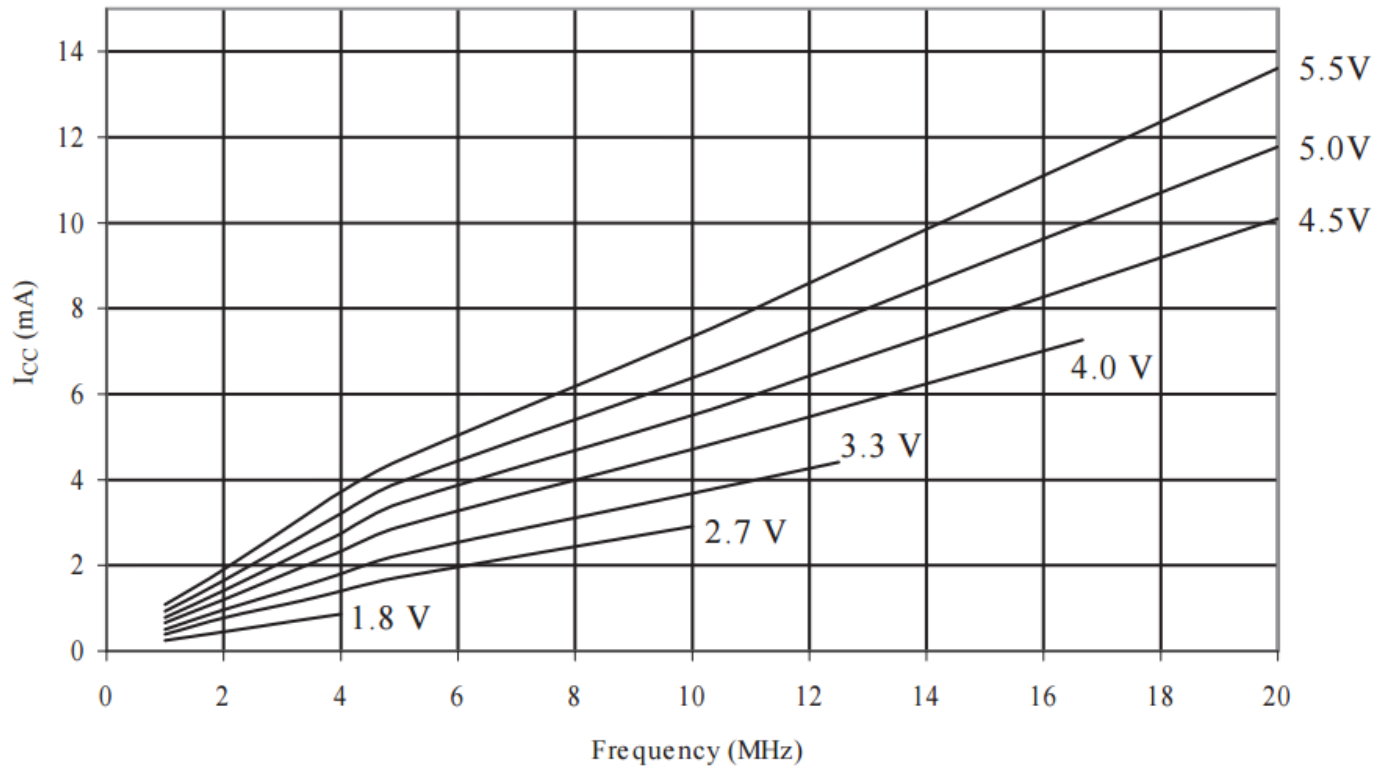
Major Components

Atmega328P-PU

- Reasons for Choice:
  Extensive documentation.
  Numerous add-ons.
  Low cost.
  Low power.
- Limitations:
  Moderate amount of GPIOs.
  Low processing power.
  Limited RAM.
  Limited storage.



re 33-2. ATmega328: Active Supply Current vs. Frequency (1MHz - 20MHz)



Atmega328P-PU – Power Consumption

- 5V at 16MHz -> ~10mA
- Using 16MHz Uxcell Quartz Crystal Oscillator
- ~50mW Power
- Low Power Mode Available
- *Datasheet list 0.2A at 1MHz

Atmega328P-PU – I/O

- 12 Digital GPIOs
- 6 Analog GPIOs
- 2 5V VCC

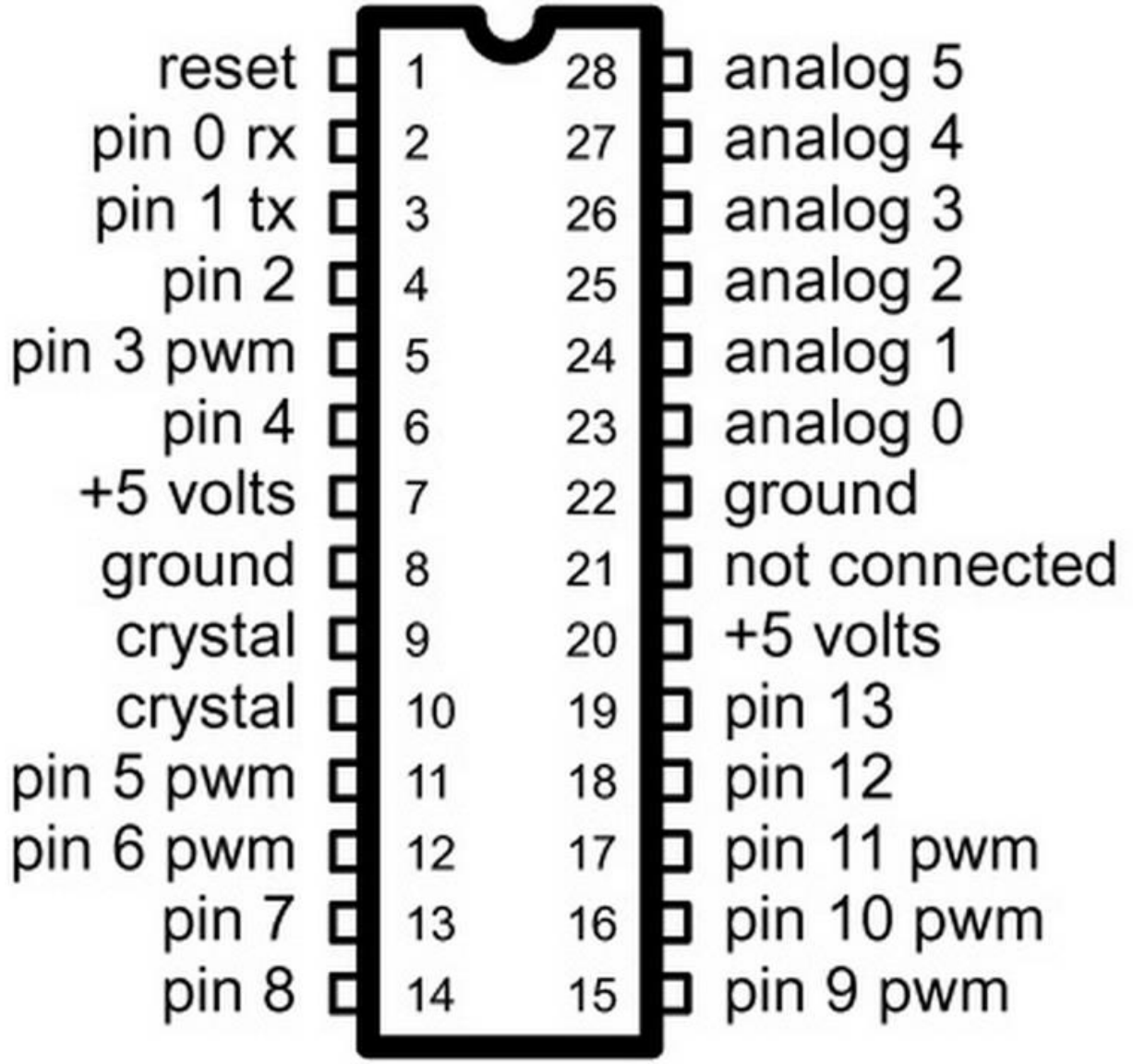
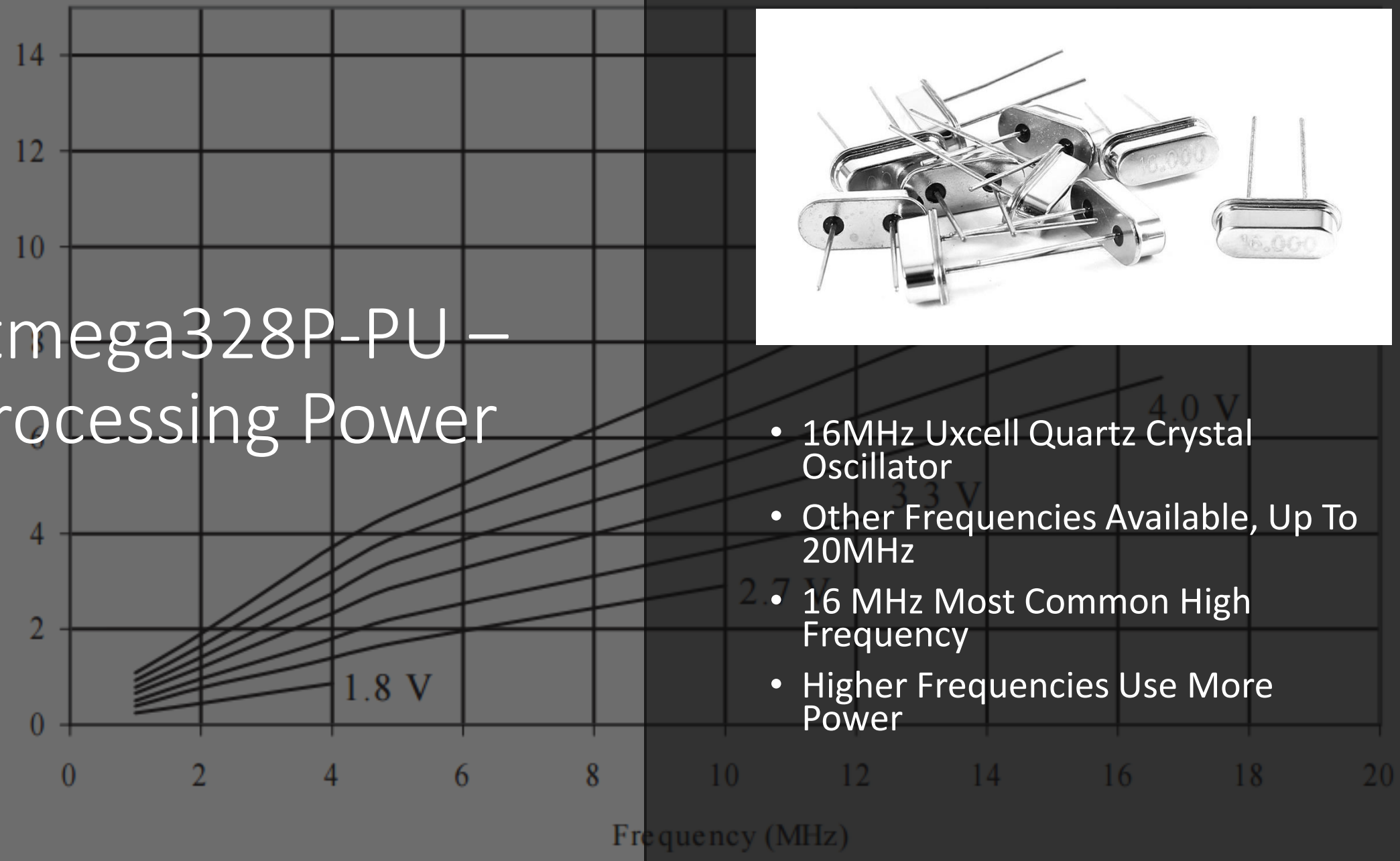


Figure 33-2. ATmega328: Active Supply Current vs. Frequency (1MHz - 20MHz)

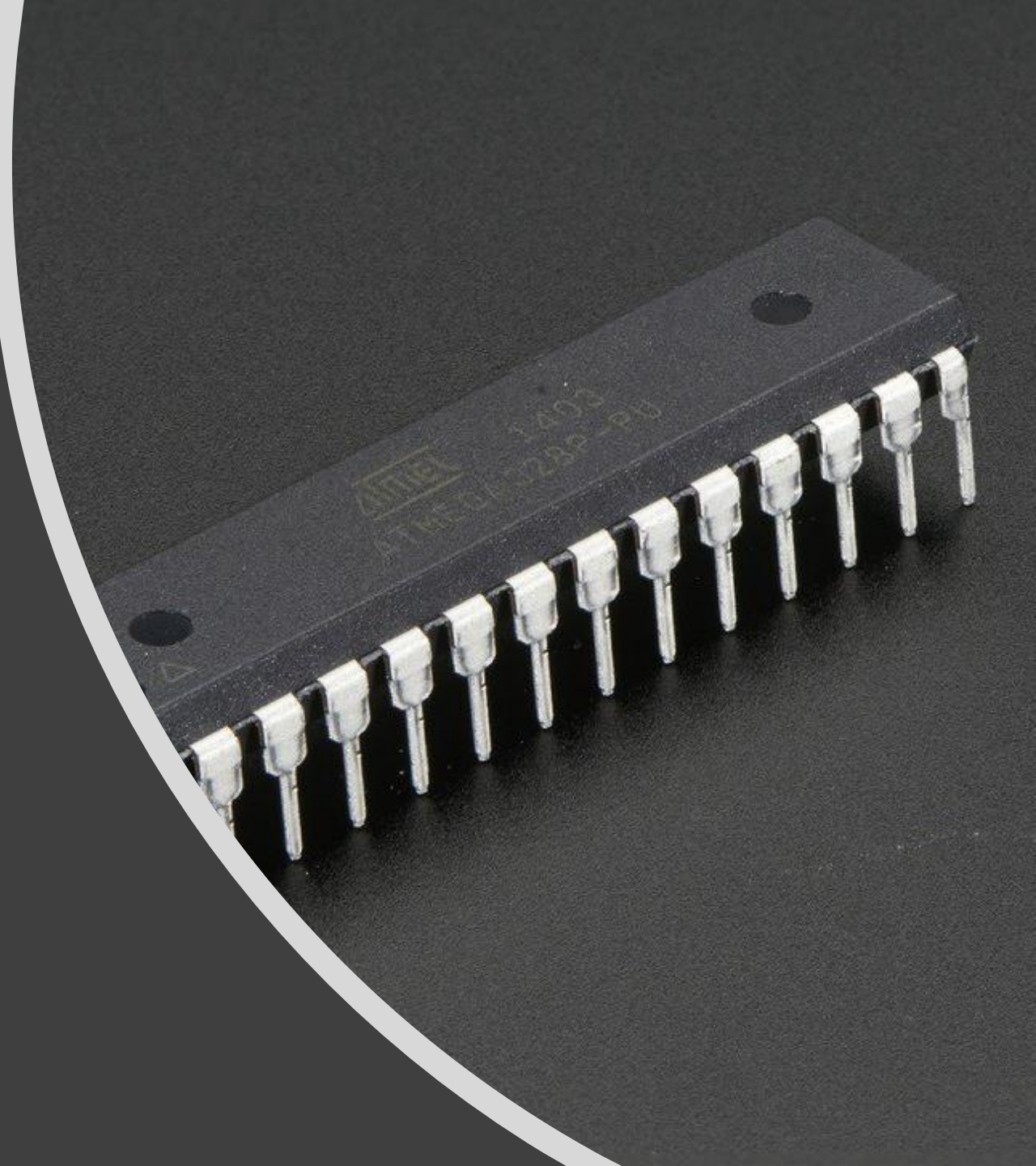


Atmega328P-PU – Processing Power

- 16MHz Uxcell Quartz Crystal Oscillator
- Other Frequencies Available, Up To 20MHz
- 16 MHz Most Common High Frequency
- Higher Frequencies Use More Power

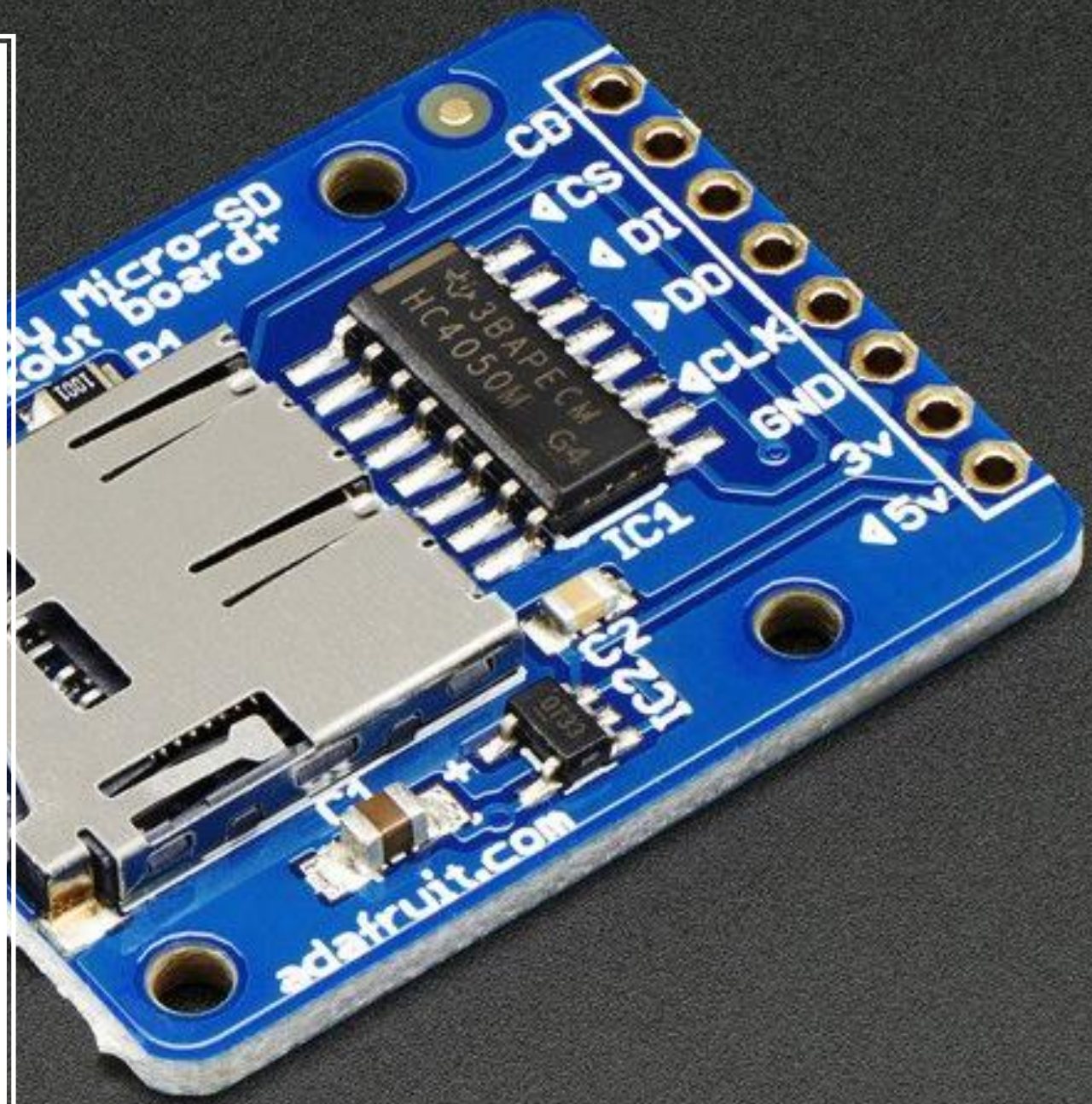
Atmega328P-PU – Program Memory & RAM

- 32 kB Program Memory Size
- 2 kB RAM Size
- 1 kB Config File Current Size
- Will not use program memory for data storage



MicroSD Card Breakout Board+

- Expands Atmega328P-PU storage.
- Used for storing incoming configuration files.
- Used for temporarily storing outgoing data.
- Used along with 16GB Patriot LX SERIES MICRO SDHC/SDXC
- 150mA max current draw for power hungry micro SD cards.
- Operates at 3V and 5V.



RASPBERRY PI 3 MODEL B

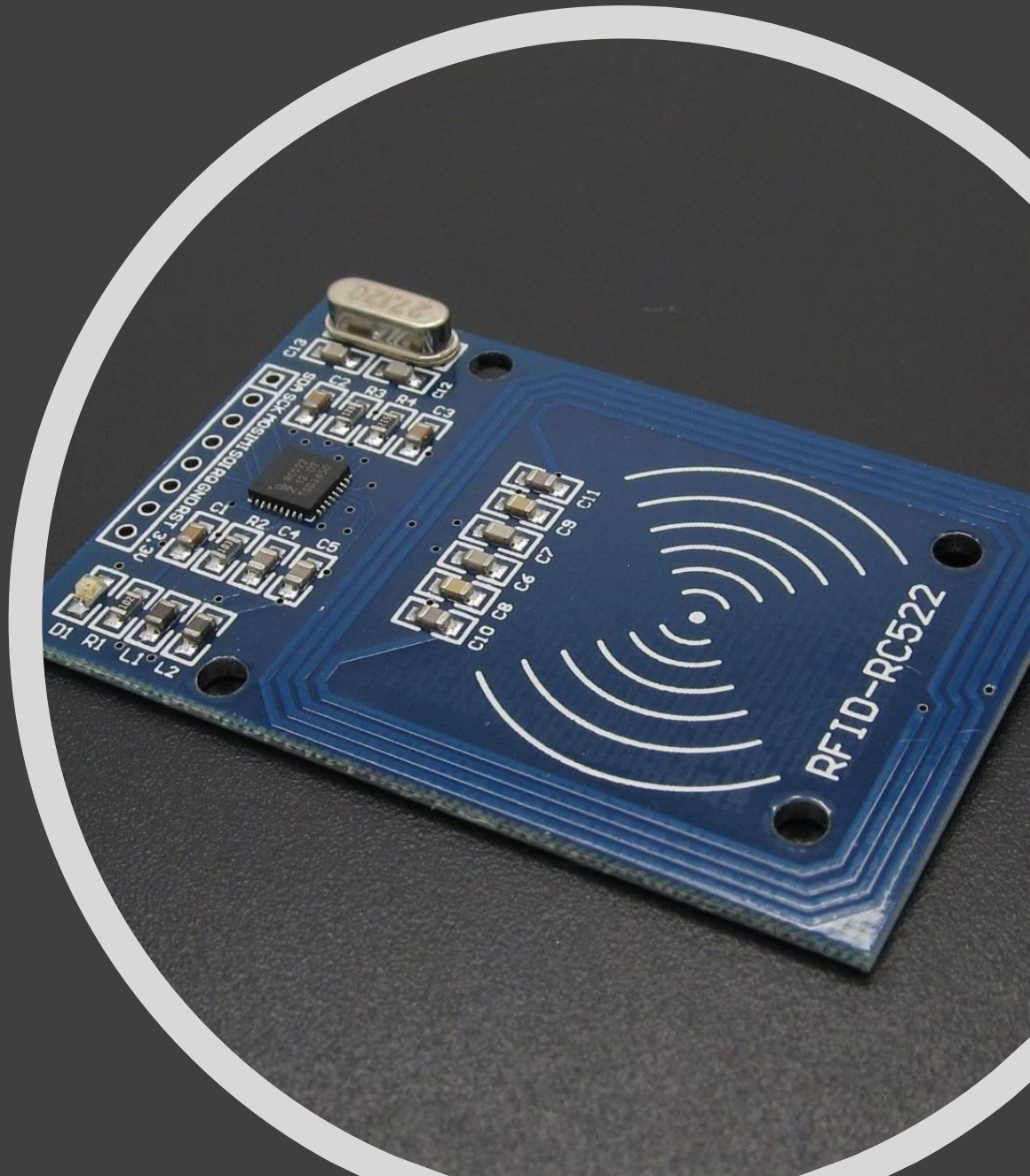
- Enables support for camera module.
- Provides additional bandwidth for image processing.
- WIFI functionality allows communication between feeder, database, and mobile application.
- Connects Atmega328P-PU to entire system.

RASPBERRY PI 3 MODEL B

- Quad Core 1.2GHz Broadcom BCM2837 64bit CPU.
- 1GB RAM.
- BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board.
- 40-pin extended GPIO.
- 4 USB 2 ports.
- 4 Pole stereo output and composite video port.
- Full size HDMI.
- CSI camera port for connecting a Raspberry Pi camera.
- DSI display port for connecting a Raspberry Pi touchscreen display.
- Micro SD port for loading your operating system and storing data.
- Upgraded switched Micro USB power source up to 2.5A.
- Micro USB power supply (2.1 A).

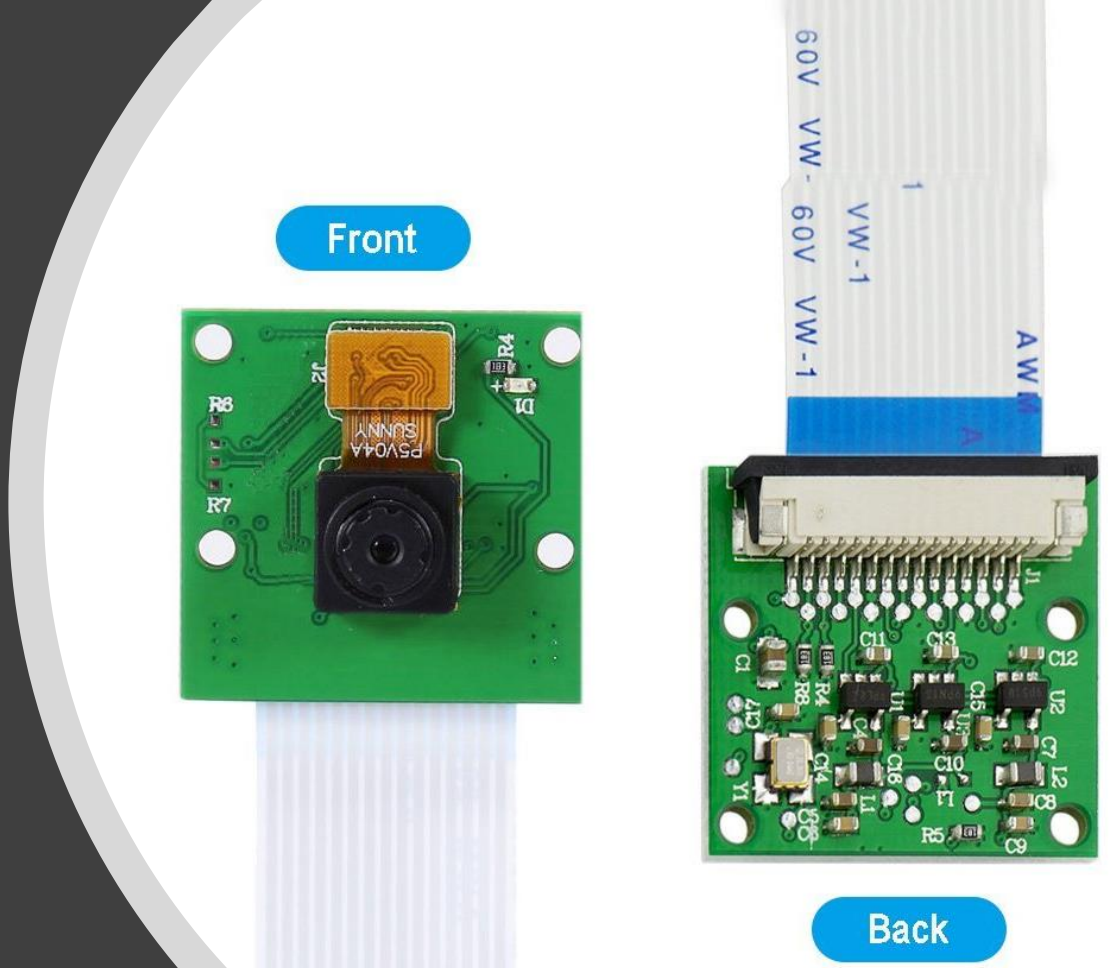
Mifare MF522-AN RFID Module

- 3.3V Operating voltage.
- 13-26mA Operating current.
- 10-13mA Idle current.
- <80uA Sleep current.
- <30mA Peak current.
- 13.56MHz Operating Frequency.
- ~3”- 8” Limited Range.



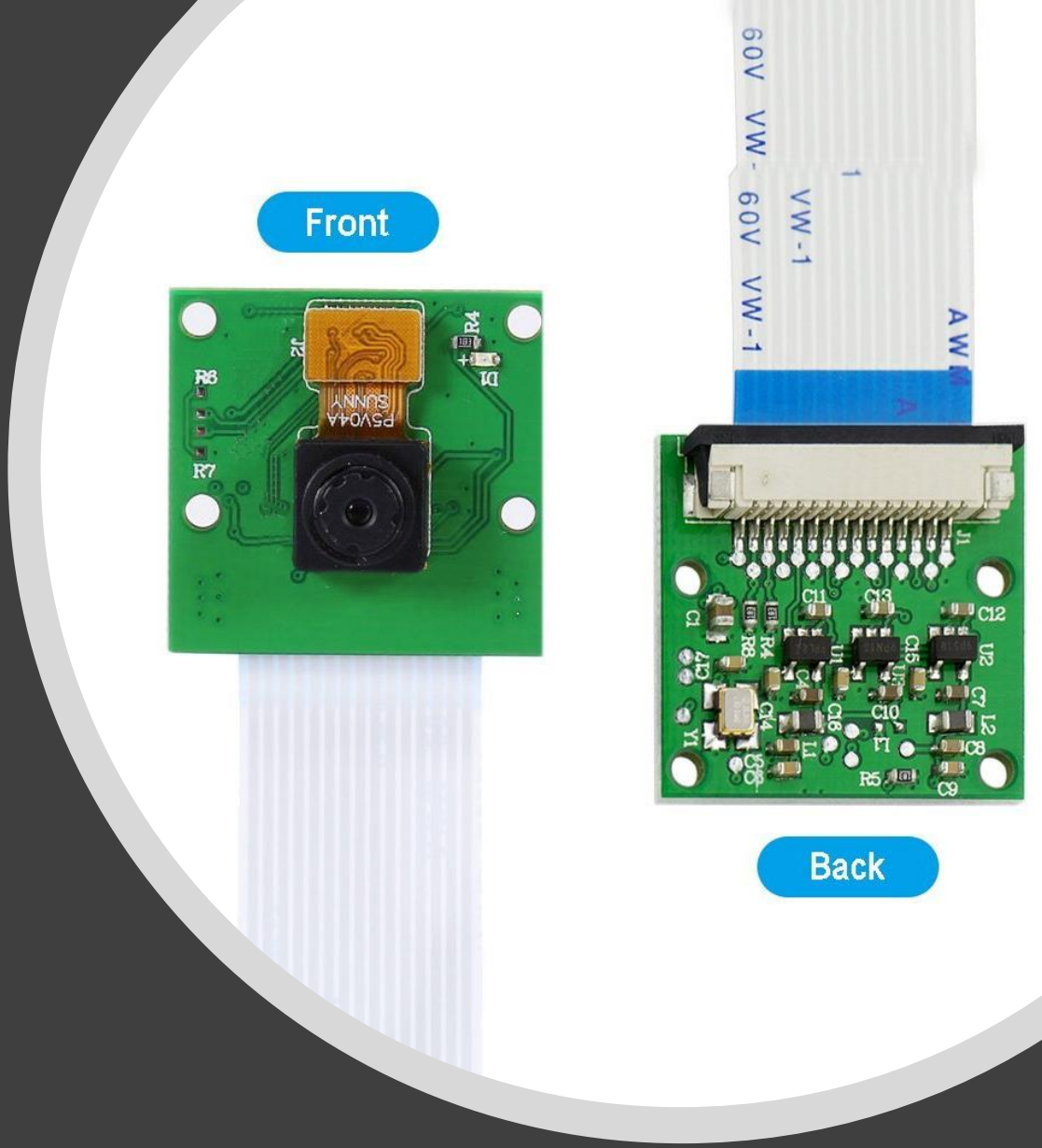
Keyestudio Camera Module

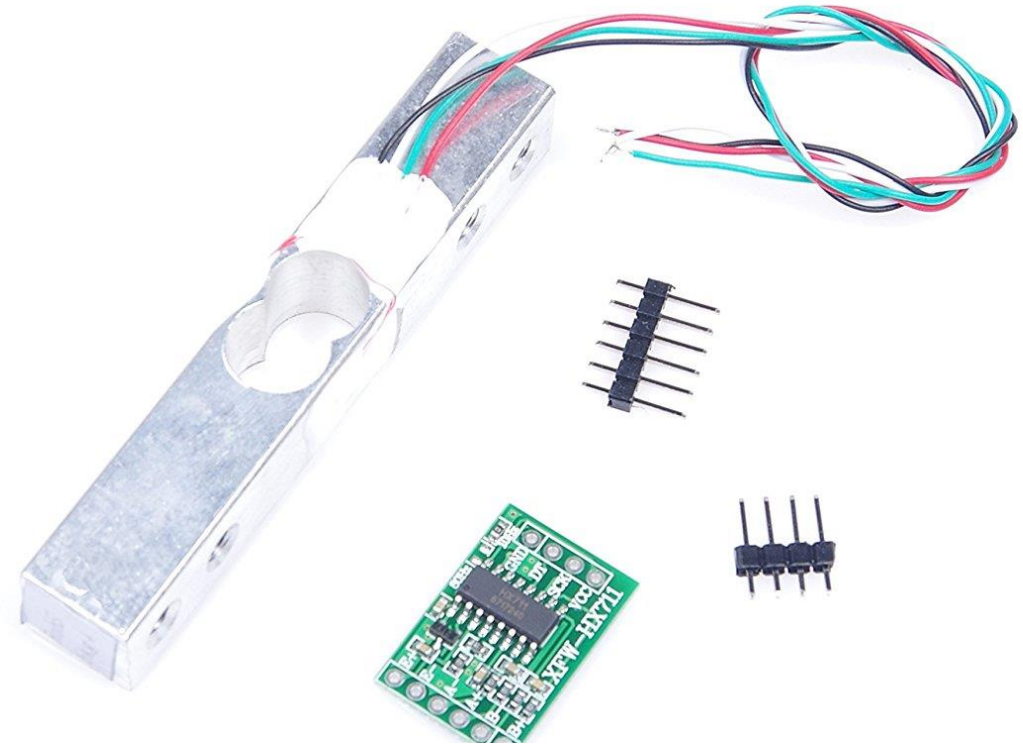
- Allows Pet Observation.
- Captures High Resolution Images.
- Video Capability in Future. Software Release.



Keyestudio Camera Module

- OV5647 Image Sensor.
- 2592 × 1944 pixel Maximum Photo Resolution.
- 1080p30, 720p60 and 640x480p90 Supported Video Resolution.
- 25mm x 24mm x 9mm Physical Dimensions.
- CSI MINI Connector Interface.
- Raspbian Supported OS.





Digital Load Cell Weight Sensor

- Used for tracking food usage.
- Used for tracking water usage.
- 5kg Max mass quantity.
- 5VDC Operating voltage.
- <1.5mA Normal operation.
- Requires 2 GPIOs.

Digital Load Cell Weight Sensor Example

ZJchao Peristaltic Liquid Pump

- Used for water dispensation.
- 12VDC Motor voltage.
- 300mA Motor current.
- 100 mL/min Flow rate.
- Limited flowrate.

Specifications	LM2596	MIC4576
Voltage Range	1.2V – 37V	1.2V – 33V
Efficiency	N/A	75%
Frequency	150kHz	200kHz
Protection Features	Thermal/Current Limiter	Thermal/Current Limiter
Price	$4.70	$3.58

Power Supply – Voltage Regulator

Reasons for Choosing LM2596

- Original design and testing performed using LM7805 and LM7812.
- Too many issues with implementing original design.
- Decided switching regulators would be ideal for our application.
- Top two choices were TI's LM2596 and the MIC4576BT by Farnell.
- Specs almost identical based decision on available documentation and product reputation.

Motor Drivers – L298N vs. TB6612FNG Comparisons

Motor Driver	Operating Voltage	Operating Current	Peak Current	H-Bridge	Size (mm)
L298N	4.5-46V	2A	3A	Bipolar Transistor	43x43x27
TB6612FNG	4.5-15V	1.2A	2-3.2A	MOSFET	20x20

Calculating the Efficiency for the Motor Driver

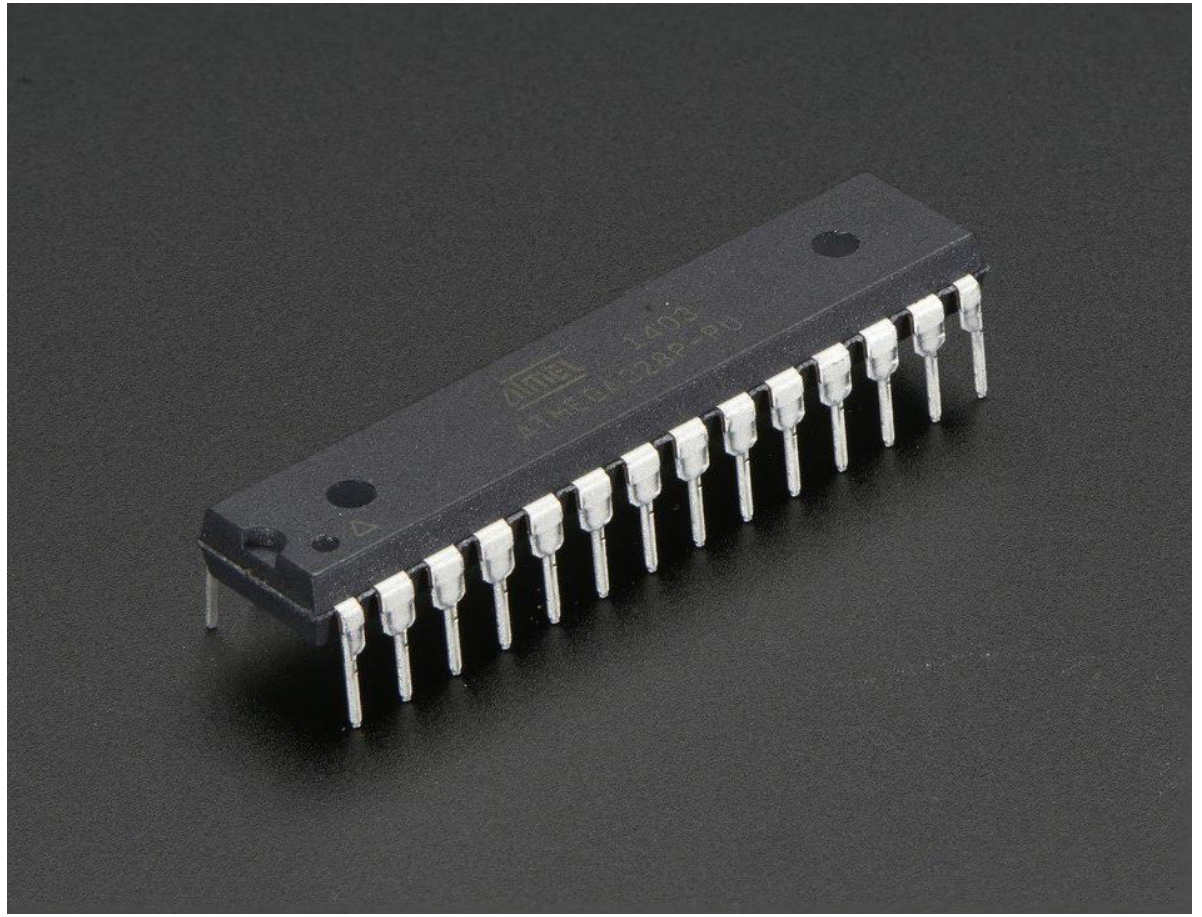
Given a supply voltage of 12V

Motor Driver	Driver Voltage	Motor Voltage	Driver Current	Motor Current	Effieciency
L298N	11.93V	10.21V	.465A	.365A	~70.2%
TB6612FNG	11.92V	11.73V	.463A	.453A	~95.97%

$$\textbf{Efficiency} = \frac{Driver\ Voltage * Motor\ Current}{Motor\ Voltage * Driver\ Current}$$

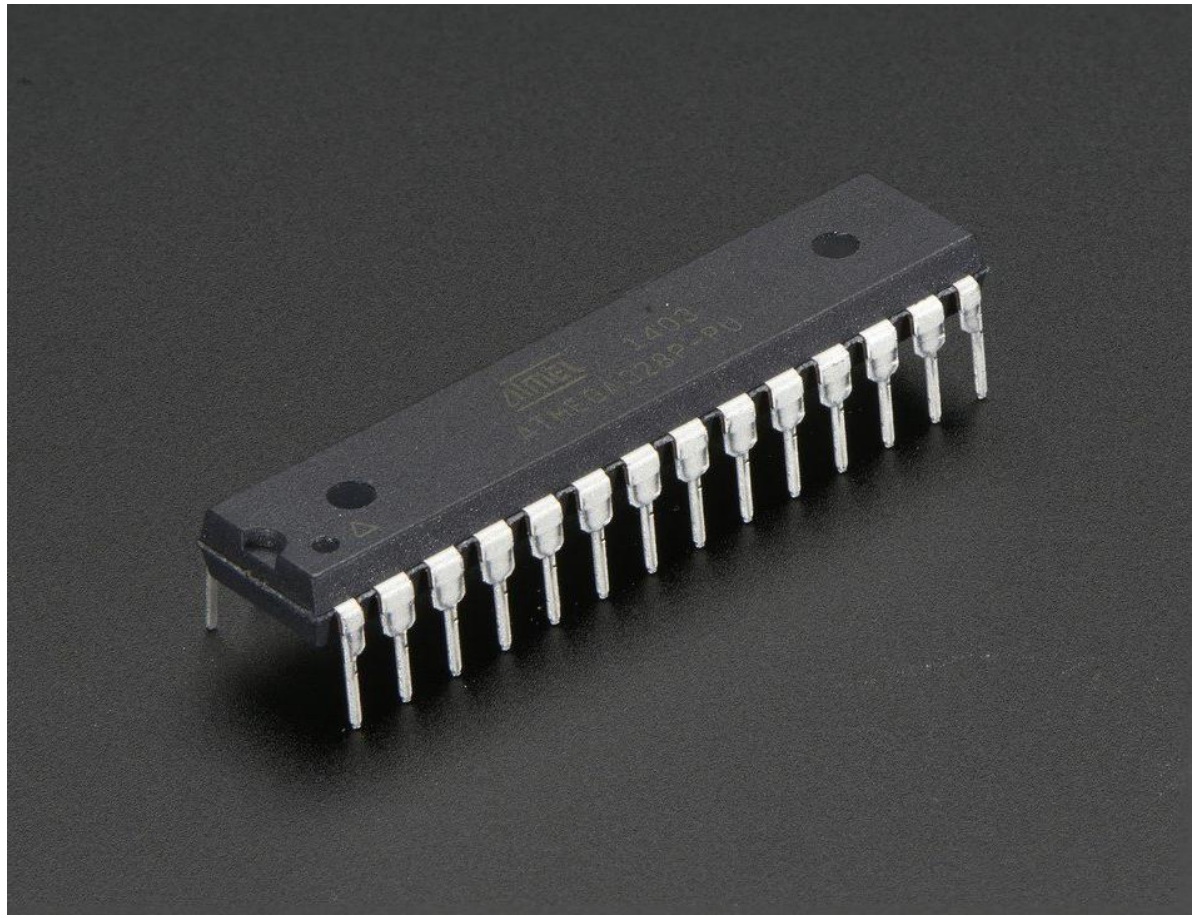
ATMEGA PWM LIMITATION ISSUES

- ATMEGA328P-PU only consist of 6 PWM pins.
- Current design layout consists of using two ATMEGA328P-PU chips.
- Original design with all peripherals consisted of too many PWM pins.
- Already purchased and designed around the ATMEGA328P-PU.
- Forced to design a more efficient design that consisted of less PWM pins.



Solving PWM Issue

- Currently looking into ways to minimized number of PWM pins.
- Limited to output current from Arduino pins.
- Possible solution would be to use a relay system to power on and off motors instead of use of motor drivers.
- In process of choosing best relay and associated components to implement for our application
- Needs to be able to take in 12VDC to power DC motor.
- If this works, we may possibly use to power and control both food dispensing and water dispensing motors.

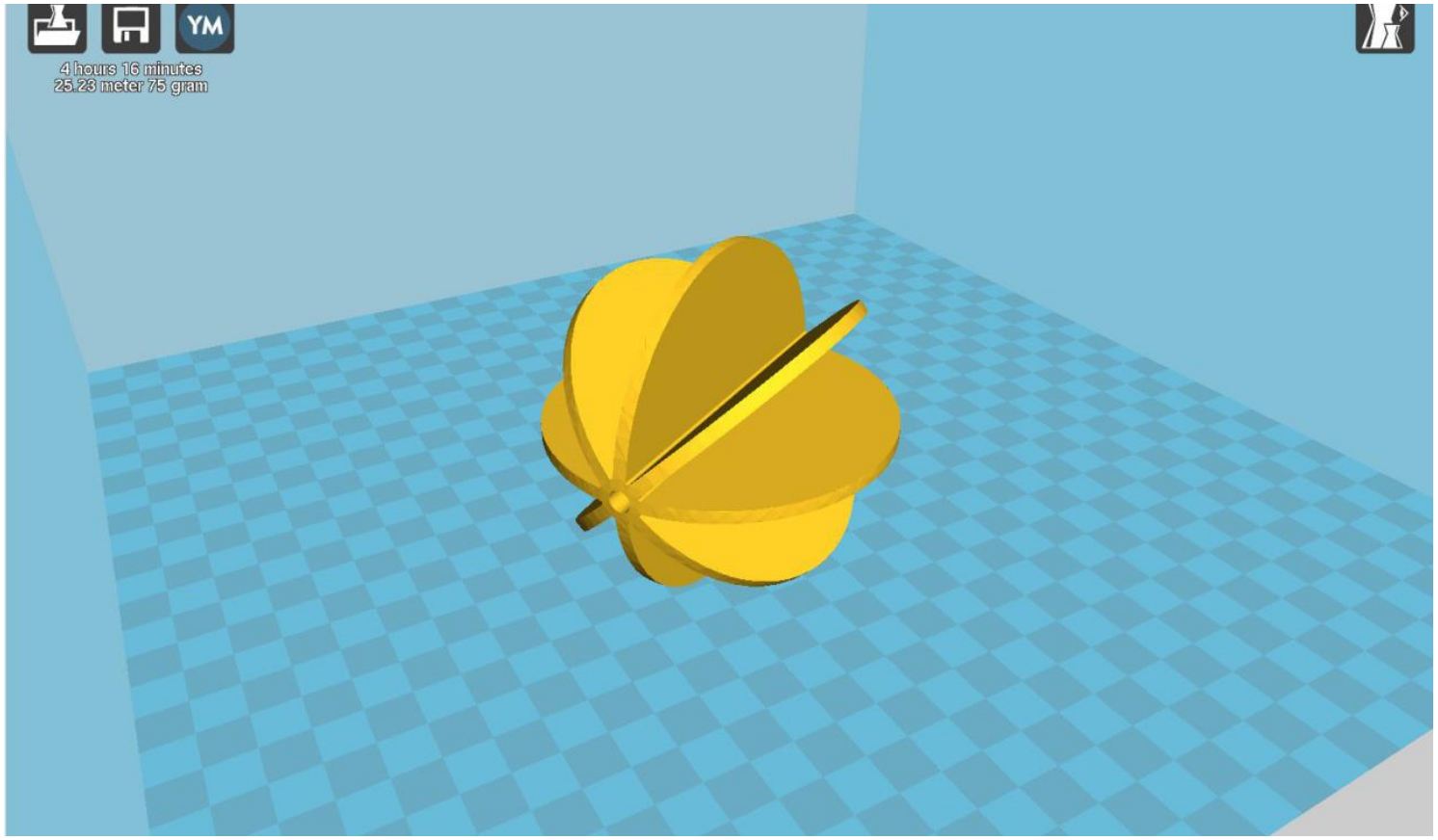


Futaba S3003 Standard Servo

- Allows single 360° revolution.
- Tracks position.
- Used for door.
- 0.23 sec/60° @ 4.8V Speed.
- 0.19 sec/60° @ 6V Speed.
- 44 oz-in (3.2 kg-cm) @ 4.8V Torque.
- 57 oz-in (4.1 kg-cm) @ 6V Torque.
- 25mA Idle current.
- 100mA Operational current.
- 400mA Stall current.

Nextrox High Torque Electric Motor

- 30 N*cm Torque
- 12VDC Voltage
- 60RPM
- Allows unlimited revolutions.
- High torque for turning food pedal.

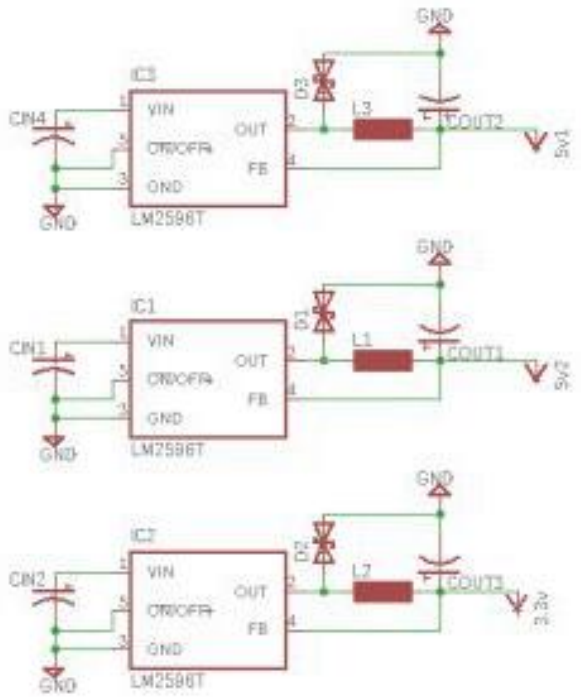


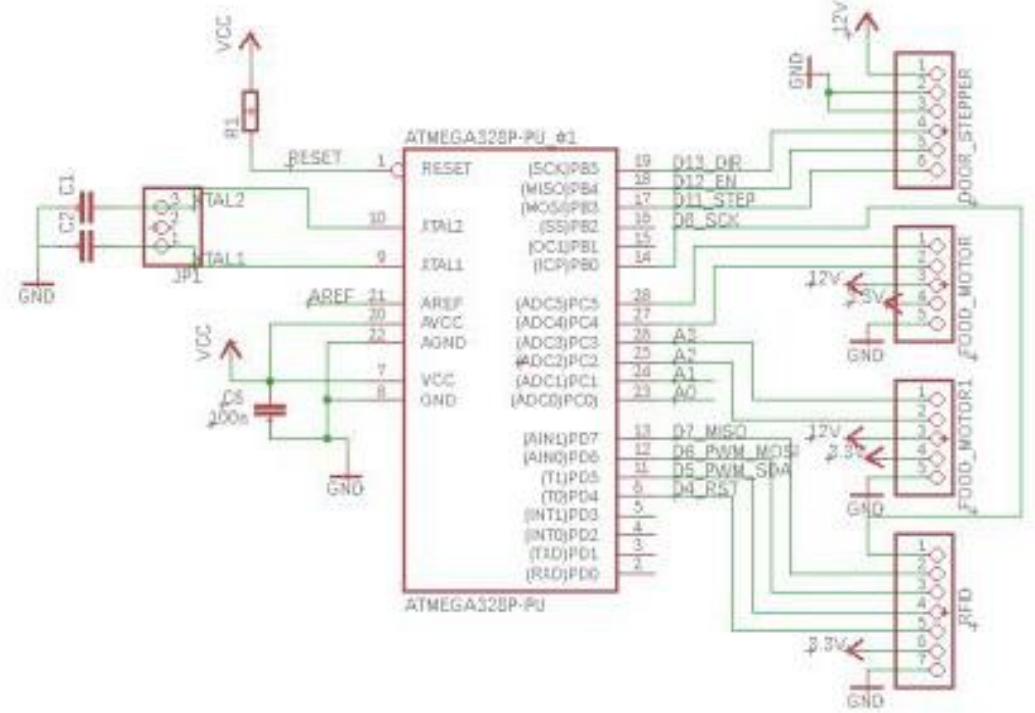
Food Dispensing Pedal

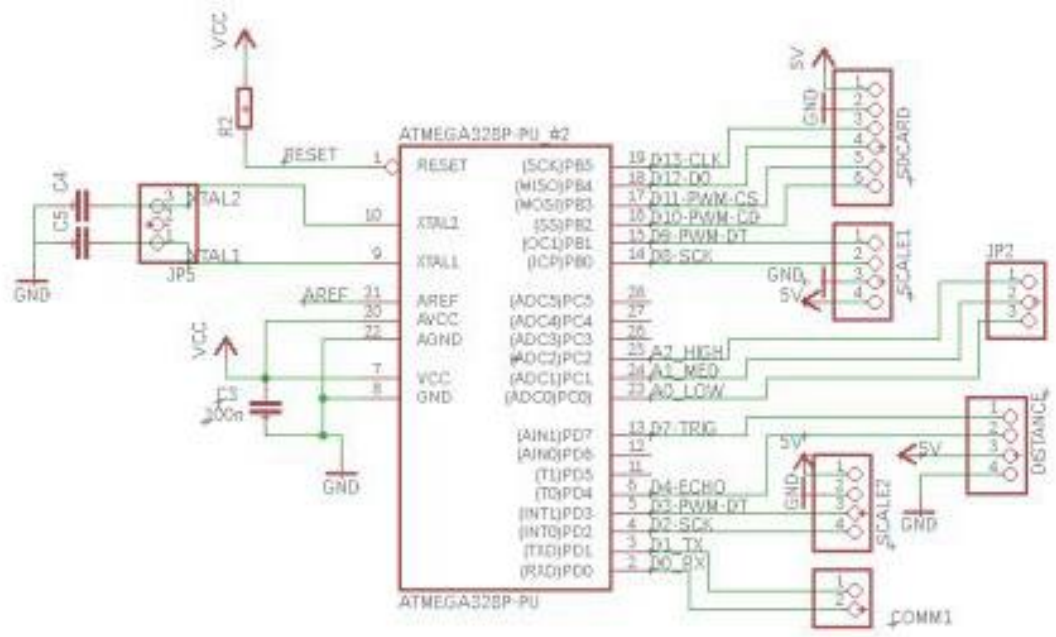
- Used in conjunction with high torque DC motor.

PCB and Schematics Designs

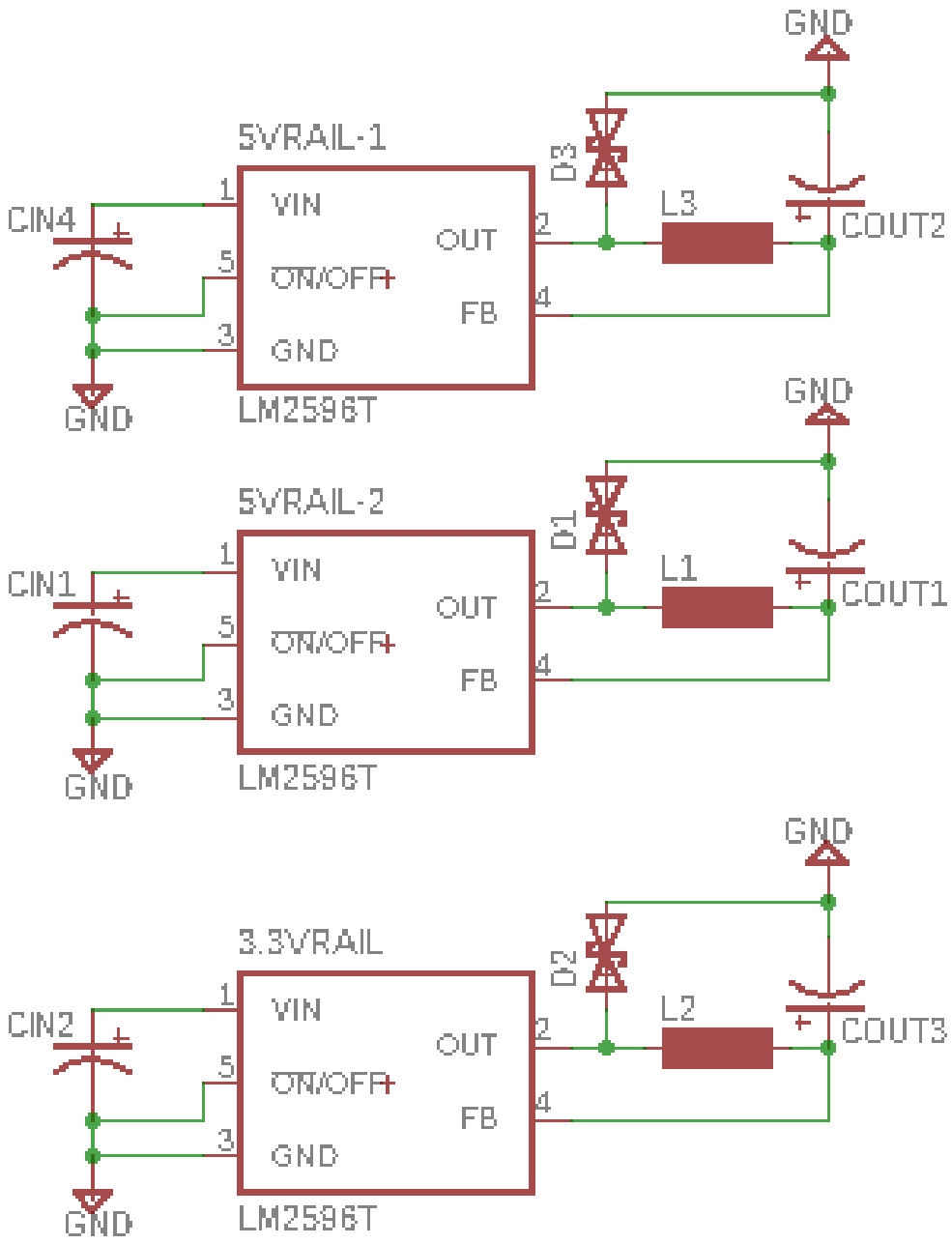
Overall Schematic





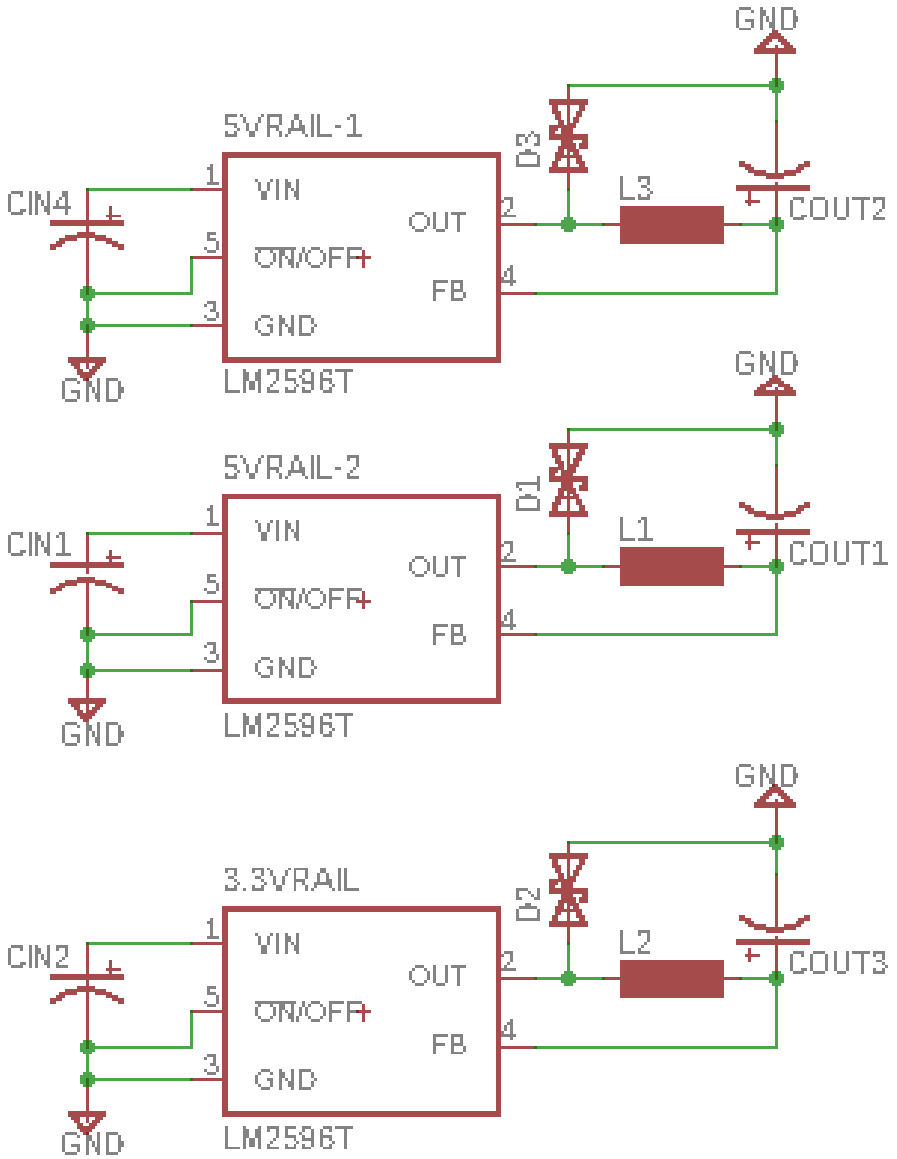


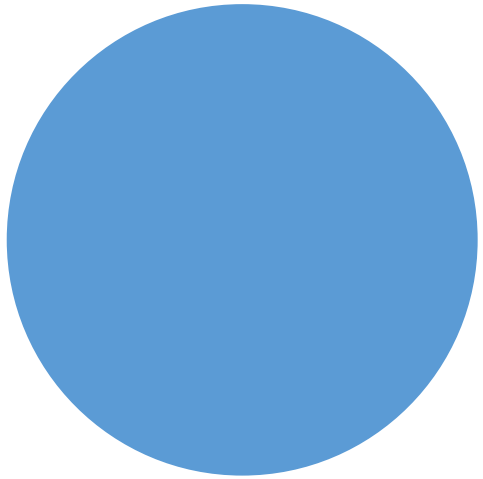
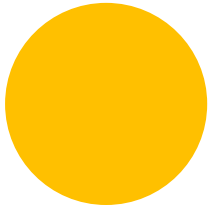
Power Supply – PCB



Power Supply – PCB

- One 12V rail.
  Primarily for motors.
- Two 5V rails.
  Primarily for larger electronics.
- One 3.3V rail.
  Primarily for smaller electronics.



Software

Raspberry Pi Webserver

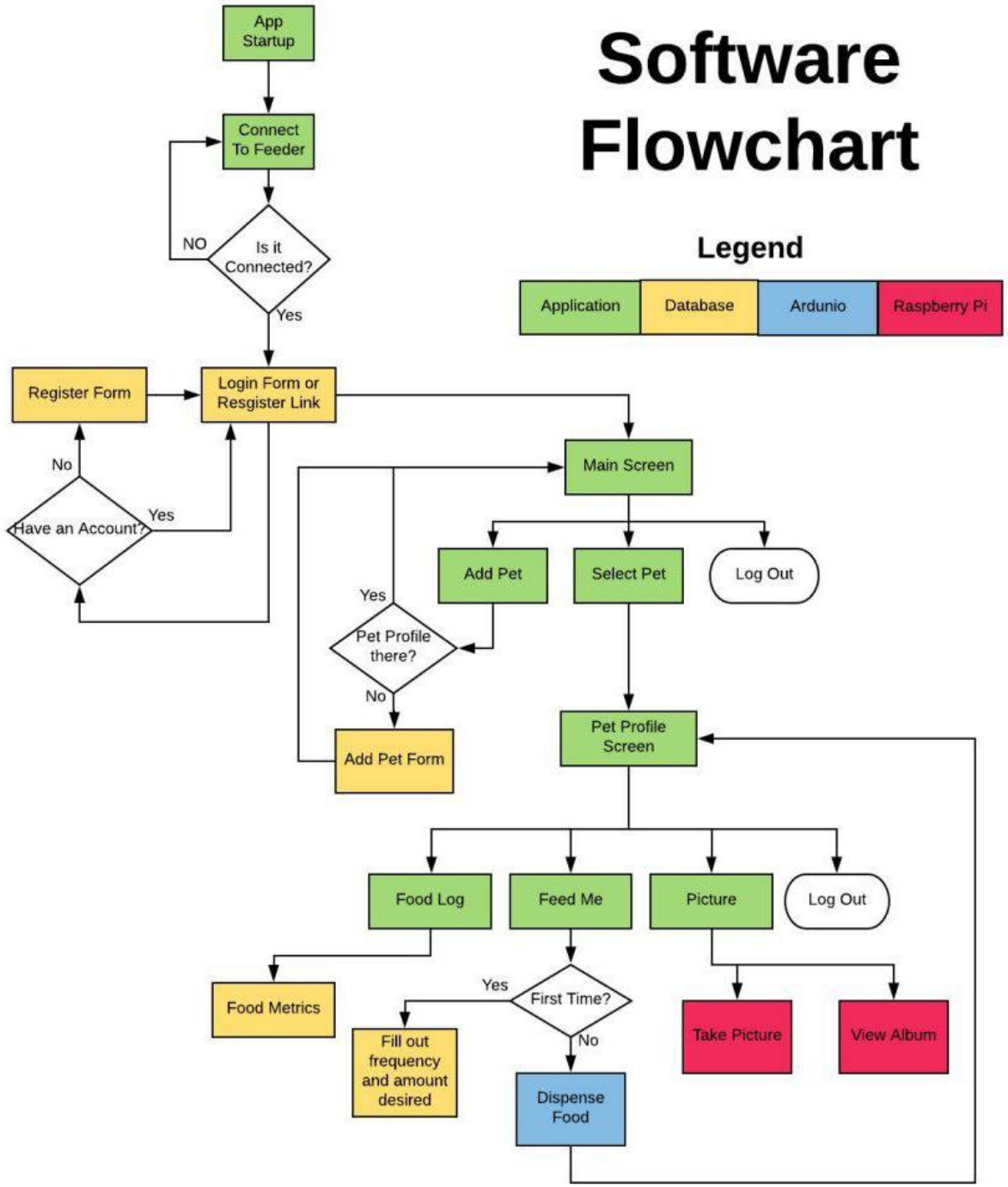
- It’s like owning your own personal cloud which means free storage.
- Free self web-hosting.
- Ability to setup site content quick and easy with allowing quick changes to content.
- Allowed to use Let’s Encrypt for free SSL Certificates unlike.

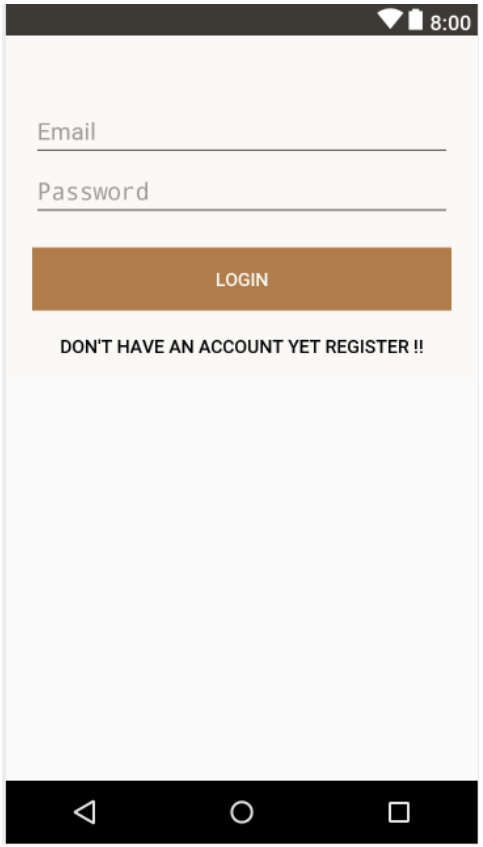
LAMP Stack

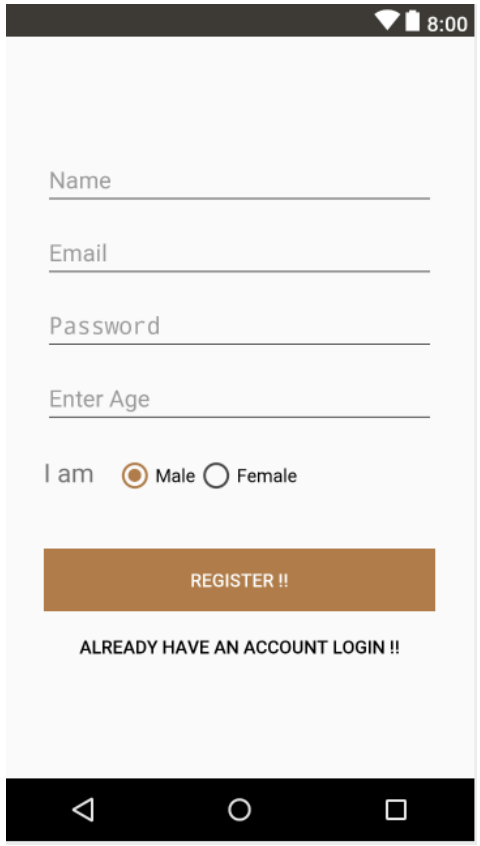
- Stands for : Linux, Apache, MySql and PHP
- Will be Used for creating and maintaining the backend and API of the app
- Will be using PHP mysqli API to connect to the Database
- Reliable and plenty of documentation
- Easy to setup on the Raspberry Pi

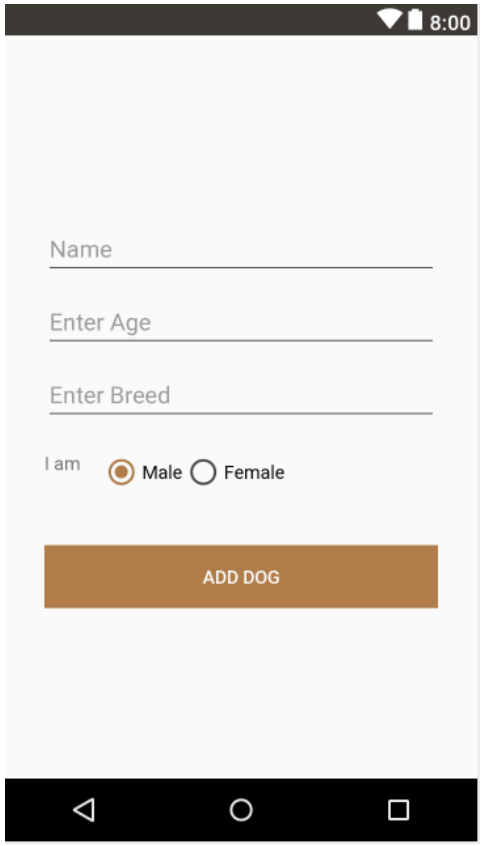
Ability to receive PUSH notifications such as:

- Pet has been fed
- When food is low
- When water level is low









Mobile Application GUI

Setting up the Configuration File

- There are two configuration files: Raspberry Pi and Signal PCB
- Raspberry Pi = Master and Signal PCB = Slave
- Configuration file updated on Pi
- Pi sends configuration file to Signal PCB

*Important for manual feeding override

Mobile App Development

Reasons for using Android Studio

- Free and Open Source
- Reduces Developers cost (One time registration fee)
- Using Java with an abundance of libraries
- Testing Emulator
- Documentation

Signal PCB Programming

Programming the ATMEGA328P-PU is done with Arduino Sketch IDE

- Very easy to use
- Open Source Software
- Can be expanded to use C++ libraries
- Much easier to incorporate objects and functions

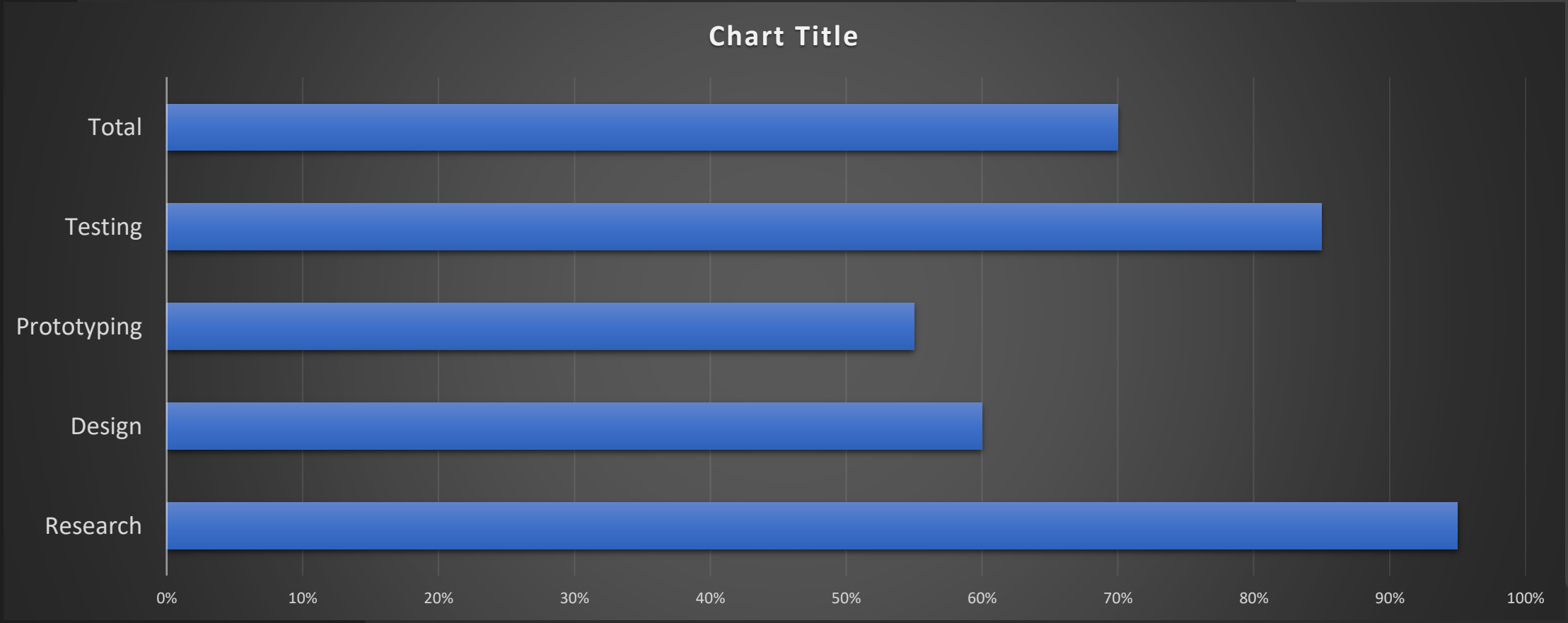
Work Distribution

Name	Electrical	Embedded Software	Application Frontend	Application Backend	Webserver	Enclosure
Paola Buitrago		Secondary	Primary	Primary	Primary	Primary
Malcolm Morgan	Secondary	Primary		Secondary		Primary
Hector Rodriguez	Primary					Primary

Administrative Content - Cost

Parts	Price	Multiplier	Subtotal
16MHz Crystal	$0.46	2	0.92
Proximity Sensor	$0.99	1	0.99
ATMEGA328P-PU	$2.50	2	5
SD Card	$5.99	1	5.99
Motor Drivers	$6.59	1	6.59
RFID Sensor	$7.98	1	7.98
SD Card Reader	$8.45	1	8.45
Camera Module	$9.99	1	9.99
AC DC 12V Adapter	$10	1	10
Miscellaneous	$10	1	10
DC Water Motor	$12.59	1	12.59
DC Food Motor	$12.98	1	12.98
Load Cell Scale	$8.50	2	17
LM2596S	$5.71	3	17.13
Printer Filament	$20.00	1	20
Raspberry Pi	$35	1	35
Total			180.61

Administrative Content - Progress



Questions?